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Industrial Portfolio Responses to Macroeconomic Shocks

An Econometric Model for Developing Countries

**James R. Tybout
and
Taeho Bark**

**Rapid changes in the exchange rate significantly affect leverage
and liquidity in the corporate sector.**

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Under what macroeconomic conditions are industrial growth and financial stability — or disaster — most likely in a semi-industrial country?

The question is addressed using an econometric model with the following features. Each firm's net income is a function of macroeconomic variables (such as output demand and interest rates) and firm-specific factors (such as physical asset shocks, currency exposure, and overall indebtedness). Each firm retains some portion of its income — how much depends on dividend policy and past earnings performance. Retained earnings add to net worth and are distributed among specific assets and liabilities according to the same macroeconomic and firm-specific variables. These incremental additions to assets and liabilities set the stage for the next period's adjustment behavior.

Application of this model to Uruguayan raw data yielded these basic findings:

- Corporate income is very sensitive to output demand and the cost of dollar credit.
- Fluctuations in corporate income have a clear, direct effect on the rate at which net worth expands.
- Firms absorb most short-run fluctuations in net worth by adjusting assets, not debts.
- Corporate demand for peso credit is very unresponsive to the real peso interest rate.

The findings imply that rapid changes in the exchange rate or aggregate demand significantly affect leverage and liquidity in the corporate sector.

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I. Introduction

Macroeconomic conditions change frequently and dramatically in the semi-industrialized countries. And in this turbulent environment, policy-makers hope the industrial sector not only remains financially sound, but manages to grow rapidly. This study identifies the macro conditions under which industrial growth and financial stability are most likely, and those conditions which are most prone to create disaster. 1/

We model interest rates, exchange rates, and aggregate demand conditions as affecting industrial growth and financial risk through two channels. First, because these variables affect firms' income, they affect firms' net worth expansion. And second, because the link between macro variables and income depends on the proportions in which firms hold fixed capital, inventories, financial assets, and debts (hereafter the "portfolio mix"), changes in macro variables also induce portfolio adjustments. This paper develops an empirical model which allows us to calibrate the strength and timing of each effect.

The model has several antecedents in the literature (Taggart, 1977; Yardeni, 1978; Jalilvand and Harris, 1984). However, it breaks new ground by (1) treating corporate net income and savings as endogenous functions of macroeconomic and firm-specific variables; (2) treating fixed capital accumulation as endogenous; (3) distinguishing between domestic and foreign currency-denominated balance sheet items; and (4) relaxing assumptions

1/ Tybout (1986) presents descriptive interpretations of the relationships between macro variables and industrial financial statements in the Southern Cone countries. However, unlike the present paper, that study does not attempt behavioral modelling.

regarding functional forms and error structures. The model is also unique in that it is estimated with micro data from a developing country.

When fit to Uruguayan data, the model yields several basic findings. First, corporate income is very sensitive to output demand and the cost of dollar credit. Second, fluctuations in corporate income have a clear direct effect on the rate of net worth expansion. Third, firms absorb most short run fluctuations in net worth via adjustments in assets, not debts. Finally, the interest elasticity of corporate demand for peso debt is very small. Inter alia, these findings imply that rapid changes in the exchange rate have large effects on corporate sector leverage and liquidity.

The remainder of the paper has two major sections; one to develop the model, and one to report an application to Uruguayan data. There is also a brief summary section.

II. A General Model of Corporate Income and Portfolio Adjustment

A. The Basic Model

Our model can be summarized as follows. Each firm's net income is a function of macroeconomic variables (like output demand and interest rates) and firm-specific factors (like physical asset stocks, currency exposure, and overall indebtedness). Once earned, some portion of this income is retained by each firm, depending upon dividend policy and past earnings performance. Retained earnings increment net worth, and are distributed among specific assets and liabilities according to, once again, macroeconomic and firm-specific variables. These increments to assets and liabilities set the stage for next period's adjustment behavior.

Suppressing firm subscripts, the complete model is presented in Table 1. For future reference we first call the reader's attention to the portfolio vector, $\underline{a}'_t = [a_{1t}, a_{2t}, \dots, a_{kt}]$, which is the focus of our analysis. This vector is defined to include a financial asset subvector $\tilde{\underline{a}}'_t = [a_{1t}, a_{2t}, \dots, a_{k-2,t}]$, inventories ($a_{k-1,t}$), and fixed capital (a_{kt}). Debts enter the financial asset subvector negatively, so summing the portfolio vector over all items yields net worth (equation 5).

We now review the model's structure, beginning with the determination of income and net worth. By accounting identity we write real net income for a representative firm in period t as equation (1). Here Y_t is real net income, G_t is operating earnings, and $\tilde{\underline{a}}'_{t-1} \tilde{\underline{x}}_t$ is the vector product of financial assets ($\tilde{\underline{a}}'_{t-1}$) held by the firm with the real yields ($\tilde{\underline{x}}_t$) these assets generate. Financial assets and real yields may be of either sign, so the second right-hand-side term of equation (1) may be positive or negative.

Real financial yields will be viewed as determined by macro conditions, and hence exogenous to the firm. So, since $\tilde{\underline{a}}'_{t-1}$ is predetermined, some assumptions regarding the determinants of operating earnings will complete the linkage between macro conditions and current net income. Suppose output (q_t) is Cobb-Douglas in labor (L_t) and beginning-of-period non-financial assets; i.e., fixed capital and inventories:

$$q_t = L_t^\eta \left(\prod_{j=k-1}^k a_{j,t-1}^{\gamma_j} \right)$$

Also let the market for manufactured products be represented as in Dixit and Stiglitz (1977), so that under Bertrand competition the representative firm believes it can sell output level q_t for price:

Table 1:The Model*Stochastic Equations

$$(2) \quad \ln(G_t) = \theta_0 + \theta_1 \ln(a_{k-1,t-1}) + \theta_2 \ln(a_{k,t-1}) + \theta_3 \ln(Q_t) + \theta_4 \ln(w_t) + e_t^g$$

$$(3) \quad \Delta W_t = \phi_1 Y_t + \phi_2 Y_{t-1} + \phi_3 \Delta W_{t-1} + e_t^w$$

$$(9) \quad \underline{a}_t = \underline{M} \underline{B} \underline{x}_t W_t + [\underline{I} - \underline{M}] \underline{a}_{t-1} + \underline{M} \underline{\delta} + \underline{e}_t^a$$

Identities

$$(1) \quad Y_t = G_t + \underline{\tilde{a}}_{t-1} ' \underline{\tilde{x}}_t$$

$$(5) \quad W_t = \sum a_{jt}$$

$$(4) \quad W_t = W_{t-1} + \Delta W_t$$

* Precise variables definitions are provided later in Table 2.

$$p_t = (Q_t/q_t)^{\sigma}$$

(Here σ^{-1} is the perceived elasticity of demand and Q_t is an index of total real expenditure on manufactured goods.) Then the representative firm will attempt to maximize short run profits at wage rate w_t by choosing output such that operating earnings, $G_t = p_t q_t - w_t L_t$, are:

$$G_t = (\xi^{\xi/(1-\xi)} - \xi^{1/(1-\xi)}) (Q_t^{\sigma/(1-\xi)}) \left(\prod_{j=k-1}^k a_{jt-1} \right)^{(1-\sigma)/(1-\xi)} (w_t^{-\xi/(1-\xi)}),$$

where $\xi = \eta(1-\sigma)$.

From this it follows that operating earnings are loglinear in the beginning-of-period quasi-fixed factors, the cost of labor, and total demand for manufactured products (equation 2). 1/ Note the correspondence between θ and structural parameters introduced above.

Equation 3 translates income into net worth changes, i.e., earnings retention. 2/ This equation is simply a restatement of the dividend model that worked best for Fama and Babiak (1968). It is based on the assumptions that desired dividends are a weighted average of current and lagged income,

1/ An earlier version of this paper assumed gross earnings depended on total financial costs, the wage rate, and output demand. However, this specification was difficult to reconcile with product market equilibrium and it fit poorly, so the above alternative has been adopted. The reported figures should thus be viewed as resulting from a specification search.

2/ We ignore new stock issues as a source of net worth expansion because they are of negligible empirical significance in the country to which the model will fit.

and since shareholders want to smooth their earnings streams, adjustment toward this desired level is partial in any period.

The linkage between macro conditions and firms' net worth is completed by the identity stated in equation (4).

It remains to motivate equation 9, which indicates how the representative firm allocates its net worth across specific portfolio items, setting the stage for next period. Suppose that, if conditions prevailing at time t were to continue indefinitely, the representative firm would like to hold some portfolio \underline{a}_t^* in steady state. Moreover, let the elements of this desired portfolio each be linear in net worth:

$$(6) \quad a_{jt}^* = \alpha_{jt} W_t + \delta_j$$

Here each δ_j is a (firm-specific) intercept term, and each α_{jt} is some linear function of a vector of variables \underline{x}_t which are considered by firms when choosing their optimal portfolio:

$$(7) \quad \alpha_{jt} = \beta_j' \underline{x}_t.$$

(The vector of financial yields, $\tilde{\underline{x}}_t$, is a subvector of \underline{x}_t .) Clearly, for the preferred portfolio to be feasible it must be that $\sum_{j=1}^k \alpha_{jt} = 1$, and $\sum_{j=1}^k \delta_j = 0$ for all t .

Finally, assume that discrepancies between \underline{a} and \underline{a}^* are eliminated via a partial adjustment process:

$$(8) \quad \underline{a}_t - \underline{a}_{t-1} = M [\underline{a}_t^* - \underline{a}_{t-1}] + \underline{e}_t^a.$$

Here \underline{M} is a matrix of partial adjustment coefficients, \underline{I} is a conformable identity matrix, and a disturbance vector \underline{e}^a has been added to establish exact equality. 1/

Combining equations 6, 7, and 8, the portfolio adjustment model may be expressed in terms of observable variables (equation 9), where: 2/

$$\underline{B}' = [\beta_1, \beta_2, \dots, \beta_k], \quad \underline{\delta}' = [\delta_1, \delta_2, \dots, \delta_k]$$

This system of k equations can be estimated along with equations 2 and 3, then used in conjunction with identities 1 and 4 to analyze the short run and longer term effects of changes in the economic environment on corporate income and portfolio choices. The variables G_t , W_t , Y_t , \underline{x}_t , \underline{a}_t , the disturbance terms e_t , and the intercept parameters $\underline{\delta}$ will all take i subscripts to index firms.

B. Econometric Issues

Several problems arise in estimating the system of equations 2, 3 and 9. First, because panel data will be used, serial correlation will be

1/ Variants on equation 8 may be found in Taggart (1977), Yardeni, (1978) and Jalilvand and Harris (1984). Unlike Taggart, we place no zero constraints on elements of \underline{M} . Also, unlike Jalilvand and Harris, we do not require that the off-diagonal elements of \underline{M} within a column be equal. Cross-equation consistency constraints implied by the identity 5 (Brainard and Tobin (1968)) are nonetheless imposed by our estimation technique, as will be seen below.

2/ Equation 9 resembles the dynamic factor demand system derived by Prucha and Nadiri (1986) if we assume exogenous variables in the system follow a first order autoregressive process. Details of the analogy are available on request.

likely: the idiosyncracies of certain firms will give them disturbances with expected values that are systematically positive or negative. Hence we view the error term in each equation as composed of a "fixed" firm effect, v , and an orthogonal random component ϵ that is serially and cross sectionally uncorrelated. For the m^{th} equation we write this $e_{it}^m = v_i^m + \epsilon_{it}^m$. Note that because this fixed effect is equivalent to a firm-specific intercept term, its use implies that estimates of the vector δ_i cannot be obtained.

Second, because the data to be used include a wide range of firm sizes, a correction for heteroskedasticity is necessary. We first perform ordinary least squares with the deviation-form data and construct firm-specific mean squared residuals (equation by equation). The square roots of these statistics are then used to weight observations for associated firms (e.g., Fomby, Hill and Johnson, 1984). ^{1/}

Finally, equation 5 implies that all columns of the parameter matrices \underline{MB} and $[\underline{I}-\underline{M}]$ in equation 9 must sum to zero except for the first column of \underline{MB} , which must sum to unity. These constraints can be imposed on the asset demand system (9) by employing a constrained Zellner-efficient estimator (e.g., Theil, chapter 6) after converting the data to mean deviation form and correcting for heteroskedasticity.

C. Interpreting Parameters

When interpreting our findings it will be pedagogically helpful to distinguish between "substitution effects" and "wealth effects." The former pertain to changes in portfolio composition induced by changes in exogenous

^{1/} Jalilvand and Harris (1984), in the only other panel data study of industrial portfolio adjustments we are aware of, employ the same mean square error correction we use.

variables, holding net worth constant. The latter pertain to the effect of exogenous variables on net worth and the scale of asset holdings (via equations 1, 2 and 3), holding constant the long run desired portfolio composition. 1/ This decomposition will be used to establish such things as whether increases in interest rates have their primary impact on firms via induced shifts in desired portfolio composition, or via reductions in income and net worth growth. Mathematically, the total impact effect of a change in some exogenous variable x_{kt} can be decomposed into the sum of these substitution and net worth effects by differentiating equation 9:

$$(10) \quad \frac{\partial z_t}{\partial x_{kt}} = \underline{MB}_{.,k} W_t + \underline{MBx}_t \left(\frac{\partial W_t}{\partial x_{kt}} \right).$$

Estimates of equation 9 provide the matrix MB; estimates of equation 2 and 3 provide the partial derivatives $\partial W_t / \partial x_{kt}$. (The subscript .,k refers to the k^{th} column of the subscripted matrix.)

Our model can also be used to contrast the impact effects of an exogenous shock with transitional and long run effects. However, because our estimates reveal all these to be qualitatively similar, we focus on impact effects.

III. An Application to Uruguay: 1973-1982

We now consider an application to Uruguay. But before discussing our variable definitions and findings, it is useful to review the major changes in the Uruguayan economy that took place during our 1973-81 sample period.

1/ Such effects have been generally ignored in earlier empirical portfolio balance models.

A. The Uruguayan Economy 1/

In 1973, the Uruguayan economy was on the brink of disaster. Inflation was accelerating toward 100%, the public sector deficit was growing, and despite numerous controls on international capital flows, the Central Bank was rapidly losing reserves. These problems were widely perceived as the cumulative result of two decades of import-substitution and a heavy reliance on state intervention.

When the military seized control in 1973, a dramatic shift toward laissez faire policies began. Interest controls were quickly phased out, restrictions on holdings of dollar deposits were eliminated, the tax system was reformed, and numerous measures to restore trade flows were taken. In addition to a large real devaluation, these latter included the removal of controls on capital good imports, a gradual reduction in the level of tariffs, and various subsidies to exporters.

The economy responded miraculously. Real GDP growth, which had averaged less than 1% per annum during the import-substitution period, jumped to over 5%, and manufacturing investment responded in kind. However, despite these welcome developments, inflation remained stubbornly around 60% per annum. Hence by 1978 policymakers had begun to focus their attention more on price stabilization and less on liberalization per se. In particular, it was decided that the traditional measures of monetary restraints were inadequate in an open economy, and that the inertia of inflationary expectations was the problem. A new, unconventional policy designed to break expectations through exchange rate management was enacted in 1979. This policy, nicknamed the

1/ For more details, see Hanson and de Melo (1985) and deMelo and Tybout (1986).

"tablita" (little tableau), was a preannounced schedule of devaluations, each smaller than the last and all significantly less than the difference between world and domestic inflation rates.

The initial impact of the tablita was to induce large capital inflows that brought real interest rates back to negative levels not seen since the years of regulatory ceilings (-20 %). But this boom period ended abruptly two years later when it became clear that the stabilization program was unsustainable. Capital inflows ceased, and peso interest rates soared to record heights. Simultaneously, external demand for Uruguayan goods rapidly dropped with maxi-devaluations in Argentina. Our sample period ends in the year of these developments, on the eve of Uruguay's own maxi-devaluations and financial crisis.

B. The Data

To link the changing Uruguayan macro environment with industrial sector growth and financial structure, we fit our model to panel data on Uruguayan firms (augmented by several macro time series). The raw data for this exercise describe 74 manufacturing firms on an annual basis from 1972 through 1981. They were collected with surveys in 1975, 1980, and 1981; then corrected for inflation bias using a variant of the "general purchasing power" system of adjustment. ^{1/} The sample, which represented roughly 65% of the total manufacturing labor force during the period of analysis, was stratified on the basis of employees (see Pascale, 1982 for details). In cases where

^{1/} General patterns that emerge from the data are described in de Melo, Pascale, and Tybout (1985). Details of the inflation adjustment procedure are provided in the World Bank Staff Working Paper version of this same study, and in Tybout (1988).

balance sheet or income statement identities did not hold exactly, the discrepancy was corrected with the assistance of the accountants who had prepared the statements. Firms whose inflation-adjusted books showed negative net worth were omitted from the sample, as were meatpacking firms, which operated subject to many special government regulations. This left 60 firms for our analysis.

C. Variable Definitions

Variable definitions for our applications to Uruguay are presented in Table 2. Several aspects of these definitions merit brief discussion.

1. The Net Income Determinants

To begin, the net income variable (Y) which appears in equations 1 and 3 is real value added net of taxes, wages, and net financial outlays. ^{1/} Hence, the appropriate definition of operating earnings (G) in equations 1 and 2 is real value added net of taxes and wages. Other accounting identities imply that real financial income ($\tilde{x}_1 - \tilde{a}_1$) amounts to real earnings on interest-bearing assets (a_2 and a_3) less the inflation loss on cash balances (a_1), less real interest payments on debt (a_4 and a_5). The vector \underline{z}_1 includes beginning-of-period physical assets, real demand for manufactured products, real wages, and a trend term.

2. The Asset Demand Equations

Our asset categories represent something of a departure from convention. First, because Uruguayan securities markets are basically limited to

^{1/} Uruguay had a value-added tax rather than a profit tax during the sample period. Wages should be interpreted to include administrative and marketing expenses.

Table 2
Variable Definitions

<u>Net Assets</u>		<u>Strictly Exogenous variables</u>	
a_1	Cash and securities	x_1	intercept term
a_2	Net peso trade credit	x_2	inflation rate
a_3	Net dollar trade credit	x_3	peso interest rate
a_4	Peso debt (sign reversed)	x_4	LIBOR rate
a_5	Dollar debt (sign reversed)	x_5	nominal peso devaluation rate
a_6	Inventories	x_6	real sales growth (firm specific)
a_7	Fixed Capital	x_7	lagged real sales growth (firm-specific)
		x_8	log [mean net worth during sample period] (firm-specific)
		w	real industrial wage rate
		Q_t	real output demand (sample-wide) <u>1/</u>

Vector Definitions

$$\underline{a}_t' \equiv [a_{1t}, a_{2t}, a_{3t}, a_{4t}, a_{5t}, a_{6t}, a_{7t}]$$

$$\underline{x}_t' \equiv [x_{1t}, x_{2t}, x_{3t}, x_{4t}, x_{5t}, x_{6t}, x_{7t}, x_{8t}]$$

$$\tilde{\underline{a}}_t' \equiv [a_{1t}, a_{2t}, a_{3t}, a_{4t}, a_{5t}]$$

$$\tilde{\underline{x}}_t' \equiv [-x_{2t}, (x_{3t} - x_{2t}), (x_{4t} + x_{5t} - x_{2t}), (x_{3t} - x_{2t}), (x_{4t} + x_{5t} - x_{2t})]$$

1/ Our output demand index is defined as sales of the entire sample divided by a manufacturing price deflator. Given that our sample is representative of manufacturing, this variable is roughly a Laspeyres quantity index.

government paper, corporate bond and stock issues can be ignored. Second, because Uruguay's dual currency system has led to important changes in the dollar exposure of firms, and because many feel this dollar exposure was a critical element of the financial crisis, we break down financial items by currency denomination wherever possible. Finally, unlike other studies, we include fixed capital among the set of assets whose size can be adjusted endogenously. In our view, this is an important improvement.

Here are several novelties in our vector of exogenous variables as well. First, because we distinguish peso and dollar-denominated assets, we include the rate of nominal devaluation in x_1 . Second, we include current and lagged real sales growth among our set of exogenous portfolio determinants. These are intended as proxies for the expected returns from "real" operations. ^{2/} Finally, because of scale economies in certain items (e.g., cash balances), large firms may have different marginal allocations of wealth than small firms, given interest rates, etc. To account for this possibility we define x_2 to include a firm size index - the logarithm of average net worth over the sample period. Thus, given the presence of a firm-specific intercept in equation 6, both the slope and the intercept of the linear relation between wealth and asset demands can shift from firm to firm.

^{1/} An earlier version of the model incorporated the real exchange rate as a proxy for expected devaluation rates. Since the results suggested that firms were able to accurately anticipate devaluation rates for the current year, we have simply included the nominal devaluation rate directly in this version. Accurate prediction was no doubt aided by the fact that devaluation rates were preannounced by the Central Bank during much of the sample period.

^{2/} An alternative model was estimated in which operating earnings per unit asset played this role -- it yielded very similar results. The version of the model with sales growth is reported here because expected sales proxies seem to be standard in the literature (Taggart, 1977; Yardeni, 1978).

D. Findings

Estimates of equations 2 and 3 are reported in Table 3, and estimates of the system 9' are reported in Table 4. Below we present interpretations.

1. Income and Net Worth Effects

From equation 10, the total impact of a change in an exogenous variable on firms' portfolios can be broken into a net worth effect and a substitution effect. In this section we interpret our findings regarding the former. For this exercise it is convenient to further break down the net worth effect of a change in the k^{th} exogenous variable into the marginal impact of the variable on income, times the marginal impact of income on net worth:

$$\underline{MBx}_t (\partial W_t / \partial x_{kt}) = (\partial Y_t / \partial x_{kt}) \underline{MBx}_t (\partial W_t / \partial Y_t)$$

We now examine each right-hand-side component of this expression.

(a) Determinants of Net Income

Equations 1 and 2 link exogenous and predetermined variables to net income. Estimated parameters for the latter appear in the upper portion of Table 2. All coefficients have expected signs, and most are of plausible magnitude. Coefficients for fixed capital and wages are exceptions, being unexpectedly small, but these are not estimated with much accuracy. (For the wage coefficient, this may be partly due to the fact that the only available series is of poor quality.) We therefore tentatively conclude that the effects of wages and fixed capital stocks on operating earnings appear to be small in the short run, and we turn our attention to other variables.

Table 3:
ESTIMATES OF θ AND ϕ FROM EQUATIONS 2 AND 3 a/

Equation 2: (Dependent variable is Operating Earnings) b/

Coefficient

$\hat{\theta}_1$ (lagged inventories)	.15** (7.40)
$\hat{\theta}_2$ (lagged fixed capital)	.01 (.73)
$\hat{\theta}_3$ (manuf. output demand)	1.15** (11.51)
$\hat{\theta}_4$ (manuf. wage rate)	-.18 (-1.33)
$\hat{\theta}_5$ (trend, total revenue)	-.01 (-1.05)
$\hat{\theta}_6$ (trend, operating costs)	-.02** (-2.55)

Equation 3: (Dependent variable is Change in Net Worth)

Coefficient

$\hat{\phi}_1$ (current net income)	.64 ** (12.57)
$\hat{\phi}_2$ (lagged net income)	-.11 (-1.88)
$\hat{\phi}_3$ (lagged change in net worth)	-.05 (-.98)

a/ Equations are estimated using data in firm-specific deviation form, hence intercepts are not estimated. Reported results are after heteroskedasticity correction.

b/ All variables in equation 2 are measured in logarithms. Operating earnings were not directly regressed on the explanatory variables. Rather, coefficients from the operating earnings equation were obtained by fitting a total revenue and an operating cost function simultaneously, imposing the appropriate cross-equation constraints. This afforded some gain in efficiency.

* 5% significance;

** 1% significance

Output Demand

Operating earnings do appear sensitive to fluctuations in the demand for manufactured goods (Table 3, $\hat{\alpha}_3$). A 10 percent drop in expenditures on manufactured goods reduces operating earnings by almost 12 percent. Or, using the fact that operating earnings are about .22 of net worth, the effect is to reduce net income by an amount equal to .026 of net worth. One can thus imagine that the sudden reduction in Argentine demand for Uruguayan products which took place in 1981 had a major effect on industrial sector profitability.

Borrowing Costs

By equation 1, increases in real borrowing cost reduce net income to the extent that firms have net financial liabilities in the associated currencies. Conversely, increases in the inflation rate reduce net income to the extent that firms have net monetary assets. To give an idea of the magnitudes involved it is useful to consider some examples based on the consolidated balance sheet for the entire sample. Specifically, in 1980, the ratio of net peso liabilities to net worth was about .15, so a 10 percentage point increase in real peso interest rates (e.g., from 0% to 10%) would have cut net income by an amount equivalent to about .015 of net worth. By similar calculations, a 10 percentage point increase in the cost of dollar credit would have cut net income by about .035 of net worth, and an increase in the inflation rate by 10 percentage points would have resulted in capital losses on monetary assets of about .015 of net worth. The average ratio of net income to net worth was about .07 in 1980, so fluctuations on this order of magnitude clearly are significant. It is noteworthy that by 1980 firms were

the most sensitive to fluctuations in the cost of dollar credit, and hence were vulnerable to large devaluations. The large Uruguayan devaluations that took place in 1982 must have greatly worsened earnings problems due to slack product markets, and turned net income negative for a large fraction of the manufacturing sector.

(b) Translating Income Effects into Wealth Effects

Once income is earned, firms must decide how much to retain, and how much to pay out to shareholders. We have represented this decision with equation 3, for which estimates are reported in the bottom half of Table 3. Very simply, it appears that roughly 64 percent of each peso of current net income is retained. Other terms in the equation have signs that confirm our basic model: desired dividends are a weighted average of current and lagged income, and only partial adjustment toward desired payout levels takes place each period. However, there appears to be a heavy bias toward current rather than lagged income in determining desired payments, and the fraction of adjustment that takes place in the current period is not significantly less than 1.

Combining equation 2 estimates with equation 3, we now have a complete representation of the chain of causation from interest rates, devaluation rates, and real output demand to net worth effects. For example, using the relationship $\partial W_t / \partial x_{kt} = (\partial W_t / \partial Y_t)(\partial Y_t / \partial x_{kt}) = .64(\partial Y_t / \partial x_{kt})$, we can calculate the impact wealth effect of a 10 percentage point increase in peso interest rates as $\partial W_t / \partial x_{2t} = .64(.10)(a_{4t-1} + a_{2t-1})$, which for a typical portfolio composition amounts to roughly a $.01W_t$ reduction in net worth growth (recall a_{2t} is negative). Alternatively, a 10 percent real devaluation would reduce net worth growth by more than $.02W_t$, reflecting the

fact that firms relied more heavily on dollar debt. Finally a 10 percent fall in manufacturing output demand reduces net worth growth by slightly less than $.02W_t$.

(c) Wealth Effects and Portfolio Composition

What influence do these short run wealth effects have on portfolio composition? Referring back to equation 10, one sees that wealth effects are translated into portfolio changes by the vector \underline{MBx}_t . This vector reflects the influence of long run desired portfolio composition (via \underline{Bx}_t) and adjustment costs (via \underline{M}). To gauge the net effect of these influences, we use estimated elements of \underline{MB} and actual \underline{x} to construct this vector year-by-year. For example in 1980, a typical year, a one unit change in net worth would have led to a .07 increase in cash, a .10 increase in net peso trade credit, virtually no change in net dollar trade credit, a .48 increase in inventories, a .42 increase in fixed capital, a .02 increase in peso borrowing and a .06 increase in dollar debt. (Figures for other years are available upon request.)

In some sense this distribution of the shock is just what one would expect -- earnings increases become liquid assets and induce fixed capital expansion. But it is surprising that virtually no adjustment to peso borrowing takes place. The implication is that standard indices of corporate financial risk -- liquidity measures and leverage -- are quite sensitive to to fluctuations in income. A firm which suffers negative earnings reduces its liquid asset stock and, because there is no reduction in peso borrowing the overall debt-equity ratio clearly rises.

2. Induced Substitution

We now turn our attention to substitution effects. Referring back to equation 10, one sees that the k^{th} column of the matrix MB, multiplied by W , represents the short run changes in portfolio holdings induced by a unit change in the k^{th} exogenous variable. Or equivalently, the k^{th} column of MB is simply the substitution-induced change in the asset vector expressed as a ratio to net worth. This fact is used below to interpret the MB and I-M matrices reported in Table 4.

Inflation Rates

Consider first the short run substitution effects of a change in the rate of inflation. Holding net worth constant, an increase in this variable changes the predicted portfolio mix according to the coefficients reported in the second row of Table 4. For example, a 100 percentage point change in the inflation rate results in a .06 reduction of cash and securities, a .03 unit reduction in peso trade credit, and a .09 increase in inventories (each expressed as a ratio to net worth). Overall, then, substitution takes place away from peso-denominated assets toward inflation hedges -- especially inventories. Notice, however, that peso borrowing is completely insensitive to the inflation rate.

Table 4: ESTIMATES OF MB AND (I-M) FROM EQUATION 9 a/ b/

Explanatory Variables		a ₁ Cash and Securities	a ₂ Peso Trade Credit	a ₃ Dollar Trade Credit	a ₄ Peso Loans	a ₅ Dollar Loans	a ₆ Inventories	a ₇ Fixed Capital
x ₁	constant	.51 ** (5.07)	-.00 (-.02)	-.11 (-1.53)	.05 (.70)	-.11 (-.88)	.49** (2.36)	.17 (1.27)
x ₂	inflation	-.06 ** (-3.69)	-.03 (-1.14)	.00 (.31)	-.00 (-.07)	-.02 (-1.16)	.09** (2.72)	.03 (1.36)
x ₃	peso interest rate	-.00 (-0.25)	.03 (1.11)	-.03 * (-2.23)	.00 (.37)	-.03 (-1.42)	.24** (7.07)	-.21** (-8.80)
x ₄	LIBOR rate	.05 (.73)	.05 (.48)	.07 (1.18)	-.03 (-.78)	.12 (1.57)	-.01 (-0.09)	-.25** (-2.88)
x ₅	devaluation rate	-.02 (-1.21)	-.06 ** (-2.36)	-.03 ** (-2.58)	-.01 (-1.40)	.06** (3.49)	.14** (4.96)	-.08** (-4.21)
x ₆	sales growth	.06 ** (6.34)	-.05 ** (-2.97)	-.00 (-.19)	-.00 (-.01)	-.02** (-2.51)	.03 (1.60)	-.02 (-1.45)
x ₇	lagged sales growth	.04 ** (3.92)	-.03 * (-1.94)	-.00 (-.25)	.01 (.88)	.00 (.38)	.05** (2.60)	-.06** (-5.31)
x ₈	log of firm size	-.04 ** (-4.55)	.01 (.82)	.01 (1.88)	-.00 (-.66)	.01 (1.20)	-.02 (-.81)	.02 (1.58)
a ₁ (-1)	Lagged cash and securities	.45 ** (12.71)	-.16 ** (-3.30)	-.02 (-.84)	-.02 (-1.00)	-.05 (-1.45)	-.16 (-3.07)	-.05** (-1.51)
a ₂ (-1)	lagged peso trade credit	-.01 (.47)	.40 ** (9.90)	-.02 (-1.21)	-.02 (-.99)	-.08** (-3.21)	-.19** (-4.42)	-.09** (-4.01)
a ₃ (-1)	Lagged dollar trade credit	.02 (.80)	-.13 ** (-2.35)	.23 * (5.16)	.02 (.86)	.10 (1.81)	-.16** (-2.39)	-.09** (-2.49)
a ₄ (-1)	Lagged peso loans	.02 (1.11)	-.13 ** (-2.85)	.04 * (2.20)	.41** (10.15)	.03 (.89)	-.24** (-4.60)	-.14** (-4.85)
a ₅ (-1)	Lagged dollar loans	.02 (1.41)	-.10 ** (-2.58)	-.01 (.59)	-.03 (-1.41)	.51** (13.29)	-.28** (-6.10)	-.11** (-4.51)
a ₆ (-1)	Lagged inventories	.04 ** (4.29)	-.02 (-.68)	.01 (.62)	-.01 (-.53)	-.06** (-2.84)	.11** (3.45)	-.07** (-4.57)
a ₇ (-1)	Lagged fixed capital	-.01 (-0.97)	-.15 ** (-6.21)	-.01 (-1.19)	.00 (.17)	-.06** (-2.69)	-.38** (-12.12)	.61** (25.67)

* Significant at the 5% level.

** Significant at the 1% level.

a/ The transpose of MB appears as the first 8 rows; the transpose of (I-M) appears as the last 7 rows.

b/ Estimated as a constrained Zellner-efficient system after expressing data in firm-specific deviation form and correcting for heteroskedasticity.

Peso Interest Rates

The substitution effects of peso interest rates also seem to conform largely to our priors. From the third row of Table 4 one sees that increases in peso rates tend to strongly discourage fixed capital holding, and encourage inventory accumulation. ^{1/} Also, dollar borrowing increases while net dollar trade credit falls, so the combined effect is to clearly increase currency exposure. Interestingly, there is once again no effect on peso borrowing. Recalling from earlier that the net worth effect of peso rates on peso borrowing is also very small, one may conclude that peso credit demand is very inelastic. This result suggests that considerable increases in interest rates may accompany minor increases in credit demand, and in particular, it may help explain the extremely high and volatile interest rates which emerged in all Southern Cone countries following interest rate decontrol. Surprisingly, previous analyses of Southern Cone interest rates have tended to overlook this explanation.

LIBOR and Devaluation Rates

The return on dollar denominated balance sheet items is the sum of the dollar interest rate (LIBOR) and the rate of peso devaluation. To test whether this sum can be treated as one explanatory variable we imposed within-equation equality of their respective coefficients and obtained an $F(7,2850)$ statistic of 2.23, which has a marginal significance level of about 97%. Thus, in view of the large number of degrees of freedom, it appears that the differences between the effects of the two variables are small, and we will not discuss each separately.

^{1/} This strongly suggests that previous portfolio models which treat physical capital as exogenous are misspecified.

The main effect of rising dollar costs is to discourage fixed capital holding and encourage the holding of inventories and trade credit. So when Uruguay slowed the devaluation rate in the latter 1970s, capital accumulation was induced by both net worth expansion (due to higher net earnings) and by shifts in portfolio composition. ^{1/} No doubt part of the explanation for the latter lies in the high import content of manufacturing sector capital.

Recalling that the net worth effects of a devaluation were also found to be strong, it is worth asking how they combined with the substitution effects identified above. Referring back to section D.1(c), one may confirm that net worth effects compound the negative substitution effect of a devaluation on cash and trade credit. So devaluation strips firms of their most liquid assets because strong net worth and substitution effects compound one another.

Sales Growth

Rapid sales growth appears to induce short run substitution toward cash, securities, and inventories. This shift is financed by reductions in fixed capital (per unit net worth) and by increased dollar borrowing. Except for the latter effect, therefore, firms which improve their sales performance tend to become more liquid; at least initially. Some of the substitution effects induced by sales growth might seem, at first glance, counter-intuitive. But one must keep in mind that the total portfolio response to a change in sales includes net worth effects as well. Hence, for example, the

1/ de Melo and Tybout (1986) found a negative association between the real exchange rate and the level of investment during the post 1973 period using Uruguayan macro data. Since low real exchange rates are associated with low rates of devaluation, this finding seems to conform to the micro results reported here.

positive impact of sales on income and net worth identified in earlier discussions easily outweighs the tendency to shift the portfolio away from fixed capital, and the familiar accelerator relationship obtains. Similarly, sales growth tends to increase net peso trade credit, once net worth effects are accounted for.

Firm Size and Portfolio Composition

It was noted earlier that scale economies and other factors may cause large firms to desire different portfolios than small firms operating in the same economic environment. We observe in passing that Table 4 confirms such effects are indeed significant, but only for cash and securities.

IV. Summary and Conclusions

Generally, Uruguayan data fit our model of corporate financial behavior well. The portfolio composition equations suggest significant substitution effects in expected directions when real yields or expected revenue growth rates change. Also, there appears to be a straightforward linkage between net income and net worth expansion. Finally, the adverse effects of contractions in output demand or financial cost increases on firms' profitability are severe in the short run. Hence, for example, major changes in the exchange regime can mean boom or bust for the industrial sector.

Examining the short-run effects of net worth expansion on balance sheet composition, we find that liquid asset stocks correlate positively with net worth growth, and peso debt does not correlate at all. So the results imply that when maxi-devaluations or other shocks reduce corporate income, operating expenses are met by drawing down net liquid assets. And of course once these stocks are exhausted, slack markets for inventories and fixed

capital could mean that firms have no way to meet their operating expenses. This problem could have been the proximate cause of the Uruguayan financial crisis that emerged in 1982 after the aggregate demand collapse.

Although net worth effects appear to be more important than substitution effects when explaining balance sheet changes, a number of the latter are noteworthy. Reductions in inflation reduce inventories and increase peso asset holdings. Increases in peso interest rates strongly discourage fixed capital formation, while inducing a shift into inventories and increasing net dollar exposure. But the effect of this variable on demand for peso-denominated items is insignificant. (The rate of devaluation appears to play a much larger role in predicting peso-dollar substitution.) One implication is that a financial liberalization program which amounts basically to interest rate decontrol is unlikely to induce much expansion in the stock of peso-denominated financial wealth. Indeed, Uruguay's expansion was apparently traceable to other factors. Equally interesting, the extremely small interest elasticity of demand for peso credit suggests a possible source of financial market instability when interest rates are decontrolled.

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